The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A device for separating water into hydrogen and oxygen and reacting oxygen with methane to form syngas, comprising a first substantially gas impervious solid electron-conducting membrane for selectively passing hydrogen, a second substantially gas impervious solid electron-conducting membrane for selectively passing oxygen, said first and said second membranes being positioned to form a reaction chamber therebetween, mechanism for passing steam at dissociation temperature into said reaction chamber such that hydrogen from the dissociation of steam selectively and continuously passes through said first substantially gas impervious solid electron-conducting membrane and oxygen from the dissociation of steam selectively and continuously passes through said second substantially gas impervious solid electron-conducting membrane thereby continuously driving the dissociation of steam producing hydrogen and oxygen, and mechanism for passing methane into said reaction chamber in the presence of oxygen thereby continuously producing a syngas of carbon monoxide and hydrogen from the reaction of oxygen and methane.

2. The device of claim 1 wherein said first and second substantially gas impervious solid electron-conducting membranes are concentric tubes forming said reaction chamber therebetween.

3. The device of claim 1 wherein said first and second substantially gas impervious solid electron-conducting membranes are concentric tubes forming a first annulus therebetween with steam therein and further comprising another first membrane

concentric with said second membrane forming a second annulus therebetween with methane therein, whereby oxygen from the dissociation of steam combines with the methane in said second annulus to form syngas of carbon monoxide and hydrogen.

4. The device of claim 3. wherein the steam is maintained at a positive pressure with respect to the hydrogen and the oxygen.

5. The device of claim 3, wherein the first and second substantially gas impervious solid electron-conducting membranes each has a thickness in the range of from about 0.002 and about 5 millimeters.

6. The device of claim 1, wherein said first substantially gas impervious solid electron-conducting membrane selectively passes atomic hydrogen.

7. The device of claim 1, wherein said first substantially gas impervious solid electron-conducting membrane selectively passes protons.

8. The device of claim 1, wherein said first substantially gas impervious solid electron-conducting membrane is one or more of Pd, Nb, V, Ta, Zr, their alloys and mixtures.

9. The device of claim 8, wherein said first substantially gas impervious solid electron-conducting membrane is supported by an oxide ceramic.

10. The device of claim 9, wherein the oxide ceramic is Al_2O_3 or yttria stabilized zirconia or SiO_2.

11. The device of claim 8, wherein said first substantially gas impervious solid electron-conducting membrane is supported by a metal.

12. The device of claim 7, wherein said first substantially gas impervious solid electron-conducting membrane is an oxide having a formula of ABO_3, wherein A is selected from the group consisting of Ba, Ca, Mg and Sr and B is $Ce_{1-x}M_x$ or $Zr_{1-x}M_x$ or $Sn_{1-x}M_x$ where X is > 0 and < 1 and M is selected from Ca, Y, Yb, In, Gd, Nd, Eu, Sm, Sr, Mg and Tb.

13. The device of claim 12, wherein an electron conductor is present as a separate phase in said first substantially gas impervious solid electron-conducting membrane and is one or more of Pt, Pd, Fe, Co, Cr, Mn, V, Nb, Ta, Zr, Y, Ni, Au, Cu, Rh, Ru, their alloys, their electron-conducting oxides, and mixtures thereof.

14. The device of claim 13, wherein the electron conductor is present in said first substantially gas impervious solid electron-conducting membrane in the range of between 30 percent by volume to about 60 percent by volume.

15. The device of claim 13, wherein the first substantially gas impervious solid electron-conducting membrane is a homogeneous mixture of a ceramic oxide and an electron conductor.

16. The device of claim 1, wherein said second substantially gas impervious solid electron-conducting membrane is Ag or a Ag alloy.

17. The device of claim 1, wherein the second substantially gas impervious solid electron-conducting membrane is a mixed metal perovskite oxide having a formula of ABO_3 wherein A is one or more of the lanthanides, Y and the rare earth metals and B is one or more of the first row of the transition metals.

18. The device of claim 1, wherein said second substantially gas impervious solid electron-conducting membrane is a two phase material with the first phase a mixed metal oxide having a formula of ABO_3 and the second phase one or more of Ag, Au, Pt, Rh, Ni, Cu, Ru, Co, their alloys, their electron-conducting oxides and mixtures thereof.

19. The device of claim 1, wherein said second substantially gas impervious solid electron-conducting membrane is a mixture of Gd doped CeO_2 and Ni.

20. The device of claim 1, wherein said second substantially gas impervious solid electron conducting membrane is a mixture of Y_2O_3 stabilized ZrO_2 and Ni or a Sr-Fe-Co oxide.

21. The device of claim 3, and further including mechanism for subjecting the syngas to a water gas shift reaction at elevated temperature and in the presence of a suitable catalyst to produce carbon dioxide and hydrogen.

22. A method of separating water into hydrogen and oxygen and thereafter reacting the oxygen with methane to produce syngas, comprising

providing a first substantially gas impervious solid electron-conducting membrane for selectively passing hydrogen, providing a second substantially gas impervious solid electron-conducting membrane for selectively passing oxygen,

and passing steam at dissociation temperature between the first and second impervious solid electron-conducting membranes such that hydrogen from the dissociation of steam selectively and continuously passes through the first substantially gas impervious solid electron-conducting membrane and oxygen from the dissociation of steam selectively and continuously passes through the second substantially gas impervious solid electron-

conducting membrane to contact methane, thereby continuously driving the dissociation of steam producing hydrogen and oxygen and producing syngas from the reaction of oxygen and methane.

23. The method of 22, wherein the steam is maintained at a temperature not less than about 400°C.

24. The method of claim 23, wherein said first substantially gas impervious solid electron-conducting membrane is one or more of Pd, Nb, V, Ta, Zr, their alloys and mixtures thereof.

25. The method of claim 24, wherein atomic hydrogen is passed by the first membrane.

26. The method of claim 24. wherein protons are passed through the first membrane and oxygen ions are passed through the second membrane.

27. The method of claim 22, wherein the second substantially gas impervious solid electron-conducting membrane is a mixed metal perovskite oxide having a formula of ABO_3 wherein A is one or more of the lanthanides, Y and the rare earth metals and B is one or more of the first row of the transition metals.

28. The method of claim 22, wherein the second substantially gas impervious solid electron-conducting membrane is a mixture of Gd doped CeO_2 and Ni or a mixture of Y_2O_3 stabilized ZrO_2 and Ni or Sr-Fe-Co oxide..